PALM Intran	et					
Application Number	1	SEARCH				
IDS Flag Cl IDS Information	earance for Ap		2			
	Content	Mailroom Date	Entry Number	IDS Review	Reviewer	
·	M844	03-01-2004	19	V	10-20-2004 18:24:10 jsmalls	s
			UPD	ATE		

WEST Refine Search Page 1 of 2

# Refine Search

### Search Results -

Term	Documents
EXCITATION	246424
EXCITATIONS	7301
PROFILE	674208
PROFILES	208394
(8 AND (EXCITATION ADJ PROFILE)).PGPB,USPT,USOC,EPAB,JPAB,DWPI,TDBD.	10
(L8 AND (EXCITATION ADJ PROFILE) ).PGPB,USPT,USOC,EPAB,JPAB,DWPI,TDBD.	10

US Pre-Grant Publication Full-Text Database

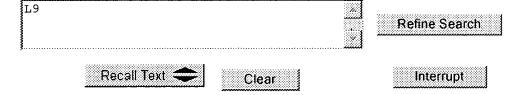
US Patents Full-Text Database

Database:

US OCR Full-Text Database EPO Abstracts Database JPO Abstracts Database Derwent World Patents Index

IBM Technical Disclosure Bulletins

Search:



### Search History

# DATE: Thursday, February 23, 2006 Printable Copy Create Case

Set Name side by side	Query	<u>Hit</u> <u>Count</u>	Set Name result set
DB=P	GPB, USPT, USOC, EPAB, JPAB, DWPI, TDBD; PLUR=YES; OP=ADJ		
<u>L9</u>	L8 and (excitation adj profile)	10	<u>L9</u>
<u>L8</u>	L1 and (computer with programm\$2)	389	<u>L8</u>
<u>L7</u>	L6 and L1 and L2	2	<u>L7</u>
<u>L6</u>	(6441615 or 6411090 or 6404199 or 6040697 or 5543711 or 4985677)	80	<u>L6</u>
<u>L5</u>	desir\$3 adj RF adj excitation	0	<u>L5</u>

<u>L4</u>	L3 and desired	0	<u>L4</u>
<u>L3</u>	L2 and L1	82	<u>L3</u>
<u>L2</u>	((collective or combined) with excitation)	3363	<u>L2</u>
<u>L1</u>	((magnetic adj resonance) or NMR or MRI) and ((transmit or excitation) with coil)	4107	<u>L1</u>

## END OF SEARCH HISTORY

# Refine Search

### Search Results -

Term	Documents
EXCITATION	246424
EXCITATIONS	7301
PROFILE	674208
PROFILES	208394
(8 AND (EXCITATION ADJ PROFILE)).PGPB,USPT,USOC,EPAB,JPAB,DWPI,TDBD.	10
(L8 AND (EXCITATION ADJ PROFILE) ).PGPB,USPT,USOC,EPAB,JPAB,DWPI,TDBD.	10

US Pre-Grant Publication Full-Text Database

US Patents Full-Text Database
US OCR Full-Text Database

Database:

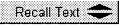
EPO Abstracts Database
JPO Abstracts Database
Derwent World Patents Index

**IBM Technical Disclosure Bulletins** 

Search:



Refine Search





Interrupt

### Search History

# DATE: Thursday, February 23, 2006 Printable Copy Create Case

Set Name side by side	Query	<u>Hit</u> Count	Set Name result set
DB=P	GPB, USPT, USOC, EPAB, JPAB, DWPI, TDBD; PLUR=YES; OP=ADJ		
<u>L9</u>	L8 and (excitation adj profile)	10	<u>L9</u>
<u>L8</u>	L1 and (computer with programm\$2)	389	<u>L8</u>
<u>L7</u>	L6 and L1 and L2	2	<u>L7</u>
<u>L6</u>	(6441615 or 6411090 or 6404199 or 6040697 or 5543711 or 4985677)	80	<u>L6</u>
<u>L5</u>	desir\$3 adj RF adj excitation	0	<u>L5</u>

<u>L4</u>	L3 and desired	0	<u>L4</u>
<u>L3</u>	L2 and L1	82	<u>L3</u>
<u>L2</u>	((collective or combined) with excitation)	3363	<u>L2</u>
<u>L1</u>	((magnetic adj resonance) or NMR or MRI) and ((transmit or excitation) with coil)	4107	<u>L1</u>

# END OF SEARCH HISTORY

### Case Folder for bshrivastav

## ⊟்@ Cases

- 720\_720\_10
- 968\_545\_10
- 904\_550\_10
- 070\_357\_11
- 984\_636\_10
- 904\_094\_10
- 981\_386\_10
- **2** 029\_811\_11
- 077\_70\_11
- **3** 077\_570<u>.</u>11
- 906\_551\_10
- 995\_765\_10
- 980\_984\_10
- 723\_312\_10

# Freeform Search

Database:	US Pre-Grant Publication Full-Text Database US Patents Full-Text Database US OCR Full-Text Database EPO Abstracts Database JPO Abstracts Database Derwent World Patents Index IBM Technical Disclosure Bulletins			
Term:	L8 and (excitation adj profile)			
Display:	Documents in <u>Display Format</u> : - Starting with Number 1			
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	Search History			

# DATE: Thursday, February 23, 2006 Printable Copy Create Case

Set Name side by side	Query	<u>Hit</u> <u>Count</u>	Set Name result set
DB=P	GPB,USPT,USOC,EPAB,JPAB,DWPI,TDBD; PLUR=YES; OP=ADJ		
<u>L9</u>	L8 and (excitation adj profile)	10	<u>L9</u>
<u>L8</u>	L1 and (computer with programm\$2)	389	<u>L8</u>
<u>L7</u>	L6 and L1 and L2	2	<u>L7</u>
<u>L6</u>	(6441615 or 6411090 or 6404199 or 6040697 or 5543711 or 4985677)	80	<u>L6</u>
<u>L5</u>	desir\$3 adj RF adj excitation	0	<u>L5</u>
<u>L4</u>	L3 and desired	0	<u>L4</u>
<u>L3</u>	L2 and L1	82	<u>L3</u>
<u>L2</u>	((collective or combined) with excitation)	3363	<u>L2</u>
<u>L1</u>	((magnetic adj resonance) or NMR or MRI) and ((transmit or excitation) with coil)	4107	<u>L1</u>

## END OF SEARCH HISTORY

Record List Display Page 1 of 13

## **Hit List**

First Hit Clear Generate Collection Print Fwd Refs Bkwd Refs

Generate OACS

**Search Results -** Record(s) 1 through 10 of 10 returned.

☐ 1. Document ID: US 20050134268 A1 Relevance Rank: 80

Using default format because multiple data bases are involved.

L9: Entry 1 of 10

File: PGPB

Jun 23, 2005

May 26, 2005

PGPUB-DOCUMENT-NUMBER: 20050134268

PGPUB-FILING-TYPE: new

DOCUMENT-IDENTIFIER: US 20050134268 A1

TITLE: Method and apparatus to generate an RF excitation consistent with a desired

excitation profile using a transmit coil array

PUBLICATION-DATE: June 23, 2005

INVENTOR-INFORMATION:

NAME CITY STATE COUNTRY

Zhu, Yudong Clifton Park NY US

US-CL-CURRENT: 324/309; 324/307

Full Title Citation Front Review Classification Data Reference Sequences Attachments Claims RMC Draw De

File: PGPB

☐ 2. Document ID: US 20050110488 A1 Relevance Rank: 79

PGPUB-DOCUMENT-NUMBER: 20050110488 PGPUB-FILING-TYPE: new

L9: Entry 3 of 10

DOCUMENT-IDENTIFIER: US 20050110488 A1

TITLE: Method and apparatus to generate an RF excitation consistent with a desired

excitation profile using a transmit coil array

PUBLICATION-DATE: May 26, 2005

INVENTOR-INFORMATION:

NAME CITY STATE COUNTRY

Zhu, Yudong Clifton Park NY US

APPL-NO: 10/723312 [PALM]
DATE FILED: November 26, 2003

Record List Display Page 2 of 13

INT-CL-PUBLISHED: [07] G01 V 3/00

US-CL-PUBLISHED: 324/309; 324/307 US-CL-CURRENT: 324/309; 324/307

REPRESENTATIVE-FIGURES: 3

#### ABSTRACT:

A system composed of multiple <u>transmit coils</u> with corresponding RF pulse synthesizers and amplifiers is disclosed. A method of designing RF pulses specific to each <u>transmit coil</u> to induce spatiotemporal variations in a composite B.sub.1 field is also disclosed. The present invention supports faithful production of desired <u>excitation profiles</u> and accommodates the use of any <u>coil</u> array geometry. The present invention also supports reduction in excitation pulse length. Through effective B.sub.1 field maps for each <u>transmit coil</u>, mutual coupling and other inter-<u>coil</u> correlations are accounted for in the RF pulse design.

Full Title Citation	Front   Review   Classificatio	n Date Reference Seque	ences Attachments Claims Hout	DIBM D

☐ 3. Document ID: US 6989673 B2 Relevance Rank: 68

L9: Entry 7 of 10 File: USPT Jan 24, 2006

US-PAT-NO: 6989673

DOCUMENT-IDENTIFIER: US 6989673 B2

TITLE: Method and apparatus to reduce RF power deposition during MR data

acquisition

DATE-ISSUED: January 24, 2006

PRIOR-PUBLICATION:

DOC-ID DATE

US 20050110487 A1 May 26, 2005

INVENTOR-INFORMATION:

NAME CITY STATE ZIP CODE COUNTRY

Zhu; Yudong Clifton Park NY US

ASSIGNEE-INFORMATION:

NAME CITY STATE ZIP CODE COUNTRY TYPE CODE

General Electric Company Schenectady NY US 02

APPL-NO: 10/723311 [PALM]
DATE FILED: November 26, 2003

INT-CL-ISSUED:

TYPE IPC DATE IPC-OLD

Record List Display Page 3 of 13

IPCP G01V3/00 20060101 G01V003/00

INT-CL-CURRENT:

TYPE IPC DATE

CIPP G01 V 3/00 20060101

US-CL-ISSUED: 324/318; 324/319 US-CL-CURRENT: 324/318; 324/319

FIELD-OF-CLASSIFICATION-SEARCH: 324/318, 324/322, 324/309, 324/307, 324/319,

324/300, 600/410

See application file for complete search history.

PRIOR-ART-DISCLOSED:

#### U.S. PATENT DOCUMENTS

PAT-NO	ISSUE-DATE	PATENTEE-NAME	US-CL
4689563	August 1987	Bottomley et al.	324/309
4782298	November 1988	Arakawa et al.	324/322
5349296	September 1994	Cikotte et al.	324/300
5758646	June 1998	Van Der Meulen et al.	600/407
6242919	June 2001	Zuk et al.	324/322
6636038	October 2003	Heid	324/314
6801037	October 2004	Zhang	324/309
6828790	December 2004	Katscher et al.	324/318

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Hayes, C.E. et al., An efficient, highly homogneous radiofrequency coil for whole-body  $\underline{\text{NMR}}$  imaging at 1.5T, Journal of  $\underline{\text{Magnetic Resonance}}$ , 1985, vol. 63, pp. 622-628. cited by other

Glover, G.H. et al., Comparison of linear and circular polarization for <u>magnetic</u> <u>resonance</u> imaging, Journal of <u>Magnetic Resonance</u>, 1985, vol. 64, pp. 255-270. cited by other

Silver, M.S. et al., Selective spin inversion in nuclear <u>magnetic resonance</u> and coherent optics through an exact solution of the Bloch-Riccati equation, Physical Revison A, 1985, vol. 31, pp. 2753-2755. cited by other

Conolly, S. et al., A selective adiabatic spin-echo pulse, Journal of <u>Magnetic</u> Resonance, 1985, vol. 83, pp. 324-334. cited by other

Foo, T.K.F. et al., Reduction of RF penetration effects in high field imaging, <a href="Magnetic Resonance"><u>Magnetic Resonance</u></a> in Medicine, 1992, vol. 23, pp. 287-301. cited by other Vaughan, J.T. et al., High frequency volume coils for clincial <a href="MIR"><u>NMR</u></a> imaging and spectroscopy, <a href="Magnetic Resonance"><u>Magnetic Resonance</u></a> in Medicine, 1994, vol. 32, pp. 206-218. cited by other

Alsop, D.C. et al., A spiral volume coil for improved RF field homogeneity at high static magnetic field strength, <u>Magnetic Resonance</u> in Medicine, 1998, vol. 40, pp. 49-54. cited by other

Duensing, G.R. et al., Transceive phased array desgined for imaging at 3.0T, Proceedings of the ISMRM 6.sup.th Scientific Meeting, 1998, p. 441. cited by other Ibrahim, T.S. et al., Effect of RF coil excitation on field inhomogeneity at ultra high fields: a field optimized TEM resonator, Magnetic Resonance Imaging, 2001, vol. 19, pp. 1139-1347. cited by other

Record List Display Page 4 of 13

Pauly, J. et al., A linear class of large-tip-angle selective excitation pulses, Journal of Magnetic Resonance, 1989, vol. 82, pp. 571-587. cited by other Conolly, S. et al., A reduced power selective adiabatic spin-echo pulse sequence, Magnetic Resonance in Medicine, 1991, vol. 18 pp. 28-38. cited by other Pruessmann, K.P. et al., SENSE: sensitvity encoding for fast MRI, Magnetic Resonance in Medicine, 1999, vol. 42, pp. 952-962. cited by other Sodickson, D.K. et al., Simultaneous acquistion of spatial harmonics (SMASH): fast imaging with radiofrequency coil arrays, Magnetic Resonance in Medicine, 1997, vol. 38, pp. 591-603. cited by other Pauly, J. et al., A k-space analysis of small-tip-angle excitation, Journal of Magnetic Resonance, 1989, vol. 81, pp. 43-56. cited by other

ART-UNIT: 2859

PRIMARY-EXAMINER: Shrivastav; Brij B.

ATTY-AGENT-FIRM: Ziolkowski Patent Solutions Group, SC

#### ABSTRACT:

A system composed of multiple <u>transmit coils</u> with corresponding RF pulse synthesizers and amplifiers is disclosed. A method of designing RF pulses specific to each <u>transmit coil</u> to dynamically control RF power deposition across an imaging volume is also disclosed, where parallel <u>excitation with the transmit coils</u> allows for management of RF power deposition on a subject while facilitating faithful production of a desired <u>excitation profile</u>. The present invention also supports reduction in scan time and is applicable to any coil array geometry.

23 Claims, 16 Drawing figures

Full Title Citation Front Review Classification Date	Reference Claims Kille Draw Do
☐ 4. Document ID: US 20050134267 A1	Relevance Rank: 67

File: PGPB

Jun 23, 2005

PGPUB-DOCUMENT-NUMBER: 20050134267

PGPUB-FILING-TYPE: new

L9: Entry 2 of 10

DOCUMENT-IDENTIFIER: US 20050134267 A1

TITLE: Method and apparatus to reduce RF power deposition during MR data acquisition

PUBLICATION-DATE: June 23, 2005

INVENTOR-INFORMATION:

NAME CITY STATE COUNTRY

Zhu, Yudong Clifton Park NY US

APPL-NO: 11/057257 [PALM]
DATE FILED: February 14, 2005

Record List Display Page 5 of 13

RELATED-US-APPL-DATA:

child 11057257 A1 20050214

parent continuation-of 10723311 20031126 US PENDING

INT-CL-PUBLISHED: [07] G01 V 3/00

US-CL-PUBLISHED: 324/309; 324/307 US-CL-CURRENT: 324/309; 324/307

REPRESENTATIVE-FIGURES: 2

#### ABSTRACT:

A system composed of multiple transmit coils with corresponding RF pulse synthesizers and amplifiers is disclosed. A method of designing RF pulses specific to each transmit coil to dynamically control RF power deposition across an imaging volume is also disclosed, where parallel excitation with the transmit coils allows for management of RF power deposition on a subject while facilitating faithful production of a desired excitation profile. The present invention also supports reduction in scan time and is applicable to any coil array geometry.

Full Title Citation Front Review Classification	Date Reference Sequences Attachm	ents Claims KNAC Draw Da
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☐ 5. Document ID: US 20050110487	A1 Relevance Rank: 67	
L9: Entry 4 of 10	File: PGPB	May 26, 2005

PGPUB-DOCUMENT-NUMBER: 20050110487

PGPUB-FILING-TYPE: new

DOCUMENT-IDENTIFIER: US 20050110487 A1

TITLE: Method and apparatus to reduce RF power deposition during MR data

acquisition

PUBLICATION-DATE: May 26, 2005

INVENTOR-INFORMATION:

NAME CITY

STATE

COUNTRY

Clifton Park Zhu, Yudong US

APPL-NO: 10/723311 DATE FILED: November 26, 2003

INT-CL-PUBLISHED: [07] G01 V 3/00

US-CL-PUBLISHED: 324/309; 324/314 US-CL-CURRENT: 324/309; 324/314

REPRESENTATIVE-FIGURES: 2

Record List Display Page 6 of 13

#### ABSTRACT:

A system composed of multiple <u>transmit coils</u> with corresponding RF pulse synthesizers and amplifiers is disclosed. A method of designing RF pulses specific to each <u>transmit coil</u> to dynamically control RF power deposition across an imaging volume is also disclosed, where parallel <u>excitation with the transmit coils</u> allows for management of RF power deposition on a subject while facilitating faithful production of a desired <u>excitation profile</u>. The present invention also supports reduction in scan time and is applicable to any coil array geometry.

Full Titl	e Citation Front Review Classification	Date: Reference   Sequences   Attachments   Claims   KMC   Draw Da
<b></b> 6.	Document ID: US 6650116 B2	Relevance Rank: 66

File: USPT

Nov 18, 2003

L9: Entry 8 of 10

US-PAT-NO: 6650116

DOCUMENT-IDENTIFIER: US 6650116 B2

\*\* See image for Certificate of Correction \*\*

TITLE: Method and system for  $\underline{\text{NMR}}$  using adiabatic RF pulses producing spatially quadratic phase

DATE-ISSUED: November 18, 2003

INVENTOR-INFORMATION:

NAME CITY STATE ZIP CODE COUNTRY Garwood; Michael G. Medina MN Ugurbil; Kamil Minneapolis MN DelaBarre; Lance St. Anthony MN Bolan; Patrick Minneapolis MN

ASSIGNEE-INFORMATION:

NAME CITY STATE ZIP CODE COUNTRY TYPE CODE

Regents of the University of Minneapolis MN 02

APPL-NO: 09/961502 [PALM]
DATE FILED: September 24, 2001

PARENT-CASE:

RELATED APPLICATION This application claims the benefit under 35 U.S.C. 119(e) of U.S. Provisional Application Serial No. 60/285,267, filed Apr. 20, 2001.

INT-CL-ISSUED: [07]  $\underline{G01}$   $\underline{V}$   $\underline{3/00}$ 

US-CL-ISSUED: 324/309; 324/307, 324/300 US-CL-CURRENT: 324/309; 324/300, 324/307

FIELD-OF-CLASSIFICATION-SEARCH: 324/300, 324/309, 324/307, 324/306, 324/303,

Record List Display Page 7 of 13

324/302, 324/318

See application file for complete search history.

#### PRIOR-ART-DISCLOSED:

#### U.S. PATENT DOCUMENTS

PAT-NO	ISSUE-DATE	PATENTEE-NAME	US-CL
4639671	January 1987	Macovski	
5057776	October 1991	Macovski	324/309
5180981	January 1993	Purdy	
5245282	September 1993	Mugler, III et al.	324/309
5274331	December 1993	Macovski	324/309
5736958	April 1998	Turpin	
5751243	May 1998	Turpin	
5821752	October 1998	LeRoux	
5827187	October 1998	Wang et al.	600/419
6043654	March 2000	Liu et al.	
6066949	May 2000	Alley et al.	
6166541	December 2000	Smith et al.	324/300
6268728	July 2001	Morrell	324/307

#### OTHER PUBLICATIONS

Devoulon, P., et al., "Profiles in <u>Magnetic Resonance</u> Imaging", MRM 31, 178-183, (1994).

Henning, J., "Chemical Shift Imaging with Phase-Encoding RF Pulses", <u>Magnetic</u> Resonance in Medicine 25, 289-298, (1992).

Johnson, G., et al., "Optimized Phase Scrambling for RF Phase Encoding", Journal of <u>Magnetic Resonance</u>, Series B 103, 59-63, (1994).

Kunz, D., "Frequencey-Modulated Radiofrequency Pulses in Spin-Echo and Stimulated-Echo Experiments", <u>Magnetic Resonance</u> in Medicine 4, 129-136, (1987).

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Mugler, J.P., et al., "Optimized Single-Slab Three-dimensional Spin-Echo MR Imaging of the Brain", Radiology, 891-899, (Sep. 2000).

Oh, C.H., et al., "Phase-Scrambled RF Excitation for 3D Volume-Selective Multislice NMR Imaging", Magnetic Resonance in Medicine 28, 290-299, (1992).

Pipe, J.G., "Spatial Encoding and Resonstruction in  $\underline{MRI}$  with Quadratic Phase Profiles", MRM 33, 24-33, (1995).

Tannus, A., et al., "Improved Performance of Frequency-Swept Pulses Using Offset-Independent Adiabaticity", Journal of <u>Magnetic Resonance</u>, Series A 120, Article No. 0110, 133-137, (1996).

ART-UNIT: 2859

PRIMARY-EXAMINER: Lefkowitz; Edward

ASSISTANT-EXAMINER: Fetzner; Tiffany A.

ATTY-AGENT-FIRM: Schwegman, Lundberg, Woessner & Kluth, P.A.

Record List Display Page 8 of 13

#### ABSTRACT:

A method and system for performing MRI and NMR spectroscopy that improves the dynamic range of the received signal by using adiabatic RF pulses for spin excitation rather than for spin inversion. The preferred adiabatic RF excitation produces a spatially varying phase across the slab, and a sharp slab profile. The phase variation is divided up by a phase-encoding gradient into voxels having a phase variation that is negligible over the width of the voxel. The phase variation in the slab-select direction is, on the whole, large enough that the peak amplitude of the received signal is reduced and the signal width broadened. This reduces the dynamic range required of the analog to digital converter used in a NMR system. A NMR system suitable for carrying out the methods of the invention is also disclosed.

30 Claims, 23 Drawing figures

Full Title Citation Front Review Clas	silication Cate Reference	Glaims   DOAC   Drawl De
☐ 7. Document ID: US 20020	153889 A1 Relevance Rank: 66	·
L9: Entry 6 of 10	File: PGPB	Oct 24, 2002

PGPUB-DOCUMENT-NUMBER: 20020153889

PGPUB-FILING-TYPE: new

DOCUMENT-IDENTIFIER: US 20020153889 A1

TITLE: Method and system for NMR using RF pulses producing quadratic phase

PUBLICATION-DATE: October 24, 2002

INVENTOR-INFORMATION:

NAME	CITY	STATE	COUNTRY
Garwood, Michael G.	Medina	MN	US
Ugurbil, Kamil	Minneapolis	MN	US
DelaBarre, Lance	St. Anthony	MN	US
Bolan, Patrick	Minneapolis	MN	US

ASSIGNEE-INFORMATION:

NAME CITY STATE COUNTRY TYPE CODE

Regents of the University of Minnesota 02

APPL-NO: 09/961502 [PALM]
DATE FILED: September 24, 2001

RELATED-US-APPL-DATA:

non-provisional-of-provisional 60285267 20010420 US

INT-CL-PUBLISHED: [07]  $\underline{G01}$   $\underline{V}$   $\underline{3}/\underline{00}$ 

US-CL-PUBLISHED: 324/307; 324/309 US-CL-CURRENT: 324/307; 324/309 Record List Display Page 9 of 13

REPRESENTATIVE-FIGURES: 1, 6

#### ABSTRACT:

A method and system for performing  $\underline{MRI}$  and  $\underline{NMR}$  spectroscopy that improves the dynamic range of the received signal by using adiabatic RF pulses for spin excitation rather than for spin inversion. The preferred adiabatic RF excitation produces a spatially varying phase across the slab, and a sharp slab profile. The phase variation is divided up by a phase-encoding gradient into voxels having a phase variation that is negligible over the width of the voxel. The phase variation in the slab-select direction is, on the whole, large enough that the peak amplitude of the received signal is reduced and the signal width broadened. This reduces the dynamic range required of the analog to digital converter used in a  $\underline{NMR}$  system. A  $\underline{NMR}$  system suitable for carrying out the methods of the invention is also disclosed.

RELATED APPLICATION

[0001] This application claims the benefit under 35 U.S.C. 119(e) of U.S. Provisional Application Serial No. 60/285,267, filed Apr. 20, 2001.

FUIL TH	e Citation Front Review	Classification Cate	Reference Sequences	Attachments	Claims 1000	ຍປະທະ ບໍ່
						······
□ 8.	Document ID: US 650	7749 B1 Re	elevance Rank: 66			

File: USPT

Jan 14, 2003

US-PAT-NO: 6507749

L9: Entry 10 of 10

DOCUMENT-IDENTIFIER: US 6507749 B1

TITLE: Method and apparatus for tracking the motion of fluid and determining a velocity spectrum thereof from MR data acquired in a single cycle

DATE-ISSUED: January 14, 2003

INVENTOR-INFORMATION:

NAME CITY STATE ZIP CODE COUNTRY
Macgowan; Christopher K. Toronto CA
Wood; Michael L. Toronto CA

ASSIGNEE-INFORMATION:

NAME CITY STATE ZIP CODE COUNTRY TYPE CODE

Sunnybrook and Women's College Toronto CA 03

APPL-NO: 09/682087 [PALM]
DATE FILED: July 18, 2001

INT-CL-ISSUED: [07]  $\underline{A61}$   $\underline{B}$   $\underline{5/05}$ 

US-CL-ISSUED: 600/419; 324/307, 324/309 US-CL-CURRENT: 600/419; 324/307, 324/309 Record List Display Page 10 of 13

FIELD-OF-CLASSIFICATION-SEARCH: 600/419, 324/307, 324/309 See application file for complete search history.

PRIOR-ART-DISCLOSED:

#### U.S. PATENT DOCUMENTS

PAT-NO	ISSUE-DATE	PATENTEE-NAME	US-CL
5054489	October 1991	Axel et al.	128/653A
5133357	July 1992	Dumoulin et al.	128/653.3
5417214	May 1995	Roberts et al.	128/653.3

#### OTHER PUBLICATIONS

 $\underline{\text{Magnetic Resonance}}$  in Medicine 45:461-469 (2001) Fast measurments of the motion and velocity spectrum of blood using MR tagging.

ART-UNIT: 3737

PRIMARY-EXAMINER: Lateef; Marvin M.

ASSISTANT-EXAMINER: Shah; Devaang

ATTY-AGENT-FIRM: Ziolkowski Patent Solutions Group, LLC Penna; Michael A. Della

Horton; Carl B.

#### ABSTRACT:

The present invention is directed to a method and system for tracking the motion of fluid traveling through a vessel and determining its velocity spectrum from magnetic resonance data collected within a single cycle. The present invention provides a process of independently acquiring and processing MR data from a single cardiac cycle. By combining a SPAMM excitation with a two-dimensional selective excitation, suitable tags of fluid flowing through the vessel may be created. The combination of the excitations produces a sinusoidal variation of transverse magnetization along a column of the fluid. A succession of gradient echoes are then collected to provide information about the flow of fluid in the excited vessel. Each gradient echo undergoes a transformation to obtain a 1-D projection of the excited fluid across the vessel. The magnitudes of the projections are then used to construct a velocity spectrum of the fluid.

28 Claims, 6 Drawing figures

Full Title Citation Front Review Classification	Date: Reference	Glaims   Konc.   Prave Pa
☐ 9. Document ID: US 6564082 B2	Relevance Rank: 40	
L9: Entry 9 of 10	File: USPT	May 13, 2003

Record List Display Page 11 of 13

US-PAT-NO: 6564082

DOCUMENT-IDENTIFIER: US 6564082 B2

TITLE: Method for incremental field-of-view-MR imaging

DATE-ISSUED: May 13, 2003

INVENTOR-INFORMATION:

NAME CITY STATE ZIP CODE COUNTRY

Zhu; Yudong Clifton Park NY

ASSIGNEE-INFORMATION:

NAME CITY STATE ZIP CODE COUNTRY TYPE CODE

General Electric Company Niskayuna NY 02

APPL-NO: 09/838635 [PALM] DATE FILED: April 19, 2001

INT-CL-ISSUED: [07] A61 B 5/05

US-CL-ISSUED: 600/410 US-CL-CURRENT: 600/410

FIELD-OF-CLASSIFICATION-SEARCH: 600/410, 600/409, 600/407, 600/408, 600/436,

600/414, 324/306, 324/307, 324/209, 476/173 See application file for complete search history.

PRIOR-ART-DISCLOSED:

#### U.S. PATENT DOCUMENTS

PAT-NO	ISSUE-DATE	PATENTEE-NAME	US-CL
5167232	December 1992	Parker et al.	128/653.3
5298862	March 1994	Hennig	324/307
5339035	August 1994	Schneider et al.	324/309
5423315	June 1995	Margosian et al.	128/653.2
5483158	January 1996	van Heteren et al.	324/318
5517118	May 1996	Crowley et al.	324/309
5617861	April 1997	Ross et al.	600/410
6037771	March 2000	Liu et al.	324/309
6043654	March 2000	Liu et al.	324/306
6144873	November 2000	Madore et al.	324/309
6181137	January 2001	Havens et al.	324/319
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6400151	June 2002	Haase et al.	324/307

#### OTHER PUBLICATIONS

Daniel K. Sodickson, WJ. Manning., "Simultaneous Acquisition of Spatial Harmonics (Smash): Fast Imaging With Radiofrequency Coil Arrays", MRM 38:591-603 (1997). Klaas P. Pruessmann, M. Weiger, MB Scheiddeger, P. Boesiger, "Sense: Sensitivity

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Encoding for Fast MRI", Institute of Biomedical Engineering and Medical Informatics, Univ. of Zurich and Swiss Federal Institute of Tech. Zurich, Switzerland, Jul. 9, 1999.

Ingrid Daubechies, "The Wavelet Transform, Time-Frequency Localization and Signal Analysis", IEEE Transactions of Information Theory, vol., 36, No. 5, Sep. 1990.

ART-UNIT: 3742

PRIMARY-EXAMINER: Walberg; Teresa

ASSISTANT-EXAMINER: Robinson; Daniel

ATTY-AGENT-FIRM: Testa; Jean K. Patnode; Patrick K.

#### ABSTRACT:

A method for producing an image of a volume of interest using a  $\underline{\text{Magnetic Resonance}}$  Imaging ( $\underline{\text{MRI}}$ ) system comprising the steps of acquiring a plurality of under-sampled  $\underline{\text{Magnetic Resonance}}$  (MR) data sets for a plurality of regions of the volume of interest along an axis of translation within the  $\underline{\text{MRI}}$  system and reconstructing the image of the volume of interest using the respective under-sampled MR data sets.

22 Claims, 7 Drawing figures

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<b>□</b> 10.	Document ID:	US 20030004408 A1	Relevance Rank:	39	
L9: Entry	5 of 10		File: PGPB	Jan	2, 2003

PGPUB-DOCUMENT-NUMBER: 20030004408

PGPUB-FILING-TYPE: new

DOCUMENT-IDENTIFIER: US 20030004408 A1

TITLE: Method for incremental field-of-view-MR imaging

PUBLICATION-DATE: January 2, 2003

INVENTOR-INFORMATION:

NAME CITY STATE COUNTRY

Zhu, Yudong Clifton Park NY US

ASSIGNEE-INFORMATION:

NAME CITY STATE COUNTRY TYPE CODE

General Electric Company 02

APPL-NO: 09/838635 [PALM]
DATE FILED: April 19, 2001

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US-CL-PUBLISHED: 600/410 US-CL-CURRENT: 600/410

REPRESENTATIVE-FIGURES: 1

#### ABSTRACT:

A method for producing an image of a volume of interest using a Magnetic Resonance Imaging (MRI) system comprising the steps of acquiring a plurality of under-sampled Magnetic Resonance (MR) data sets for a plurality of regions of the volume of interest along an axis of translation within the MRI system and reconstructing the image of the volume of interest using the respective under-sampled MR data sets.

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Apr 1, 2003

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**Search Results -** Record(s) 1 through 2 of 2 returned.

☐ 1. Document ID: US 5349294 A Relevance Rank: 51

Using default format because multiple data bases are involved.

L7: Entry 2 of 2

File: USPT Sep 20, 1994

US-PAT-NO: 5349294

DOCUMENT-IDENTIFIER: US 5349294 A

TITLE: Two and three-dimensionally selective RF pulses for magnetic resonance

imaging

DATE-ISSUED: September 20, 1994

INVENTOR-INFORMATION:

NAME CITY STATE ZIP CODE COUNTRY

Kasuboski; Larry Solon OH

US-CL-CURRENT: 324/309

Full Title Citation Front Review Classification Cale Reference: Claims FMC Draw D.

☐ 2. Document ID: US 6541971 B1 Relevance Rank: 50

L7: Entry 1 of 2 File: USPT

US-PAT-NO: 6541971

DOCUMENT-IDENTIFIER: US 6541971 B1

TITLE: Multi-dimensional spatial NMR excitation

DATE-ISSUED: April 1, 2003

INVENTOR-INFORMATION:

NAME CITY STATE ZIP CODE COUNTRY

Dannels; Wayne R Richmond Hts. OH

ASSIGNEE-INFORMATION:

NAME CITY STATE ZIP CODE COUNTRY TYPE CODE

Koninklijke Philips Electronics, N.V. Eindhoven NL 03

Record List Display Page 2 of 3

APPL-NO: 09/894784 [PALM]
DATE FILED: June 28, 2001

INT-CL-ISSUED: [07]  $\underline{G01}$   $\underline{V}$   $\underline{3}/\underline{00}$ 

US-CL-ISSUED: 324/309; 324/307, 324/318 US-CL-CURRENT: 324/309; 324/307, 324/318

FIELD-OF-CLASSIFICATION-SEARCH: 324/309, 324/307, 324/310, 324/311, 324/314,

324/318, 128/653.2, 128/653.5

See application file for complete search history.

PRIOR-ART-DISCLOSED:

#### U.S. PATENT DOCUMENTS

DAM NO	TOOLIN DAMP		
PAT-NO	ISSUE-DATE	PATENTEE-NAME	US-CL
4297637	October 1981	Crooks et al.	324/309
4318043	March 1982	Crooks et al.	324/309
4480228	October 1984	Bottomley	324/309
4563647	January 1986	Young	324/309
4651097	March 1987	Iwaoka et al.	324/309
4714883	December 1987	Ordidge	324/309
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4985677	January 1991	Pauly	324/309
5010300	April 1991	Paley et al.	324/309
5122748	June 1992	Oh et al.	324/309
5349294	September 1994	Kasuboski	324/309
5699801	December 1997	Atalar et al.	128/653.2
6411089	June 2002	Anand et al.	324/309

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FOREIGN-PAT-NO PUBN-DATE COUNTRY CLASS 0 290 608 December 1988 EP

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Edelman, et al. "FRODO Pulse sequences: A new means of Eliminating Motion, Flow, and Wrap around Artifacts". Radiology, 166: 231-236, 1988.

Shaka, et al. "Spatially Selective Radiofrequency Pulses". Journal of <u>Magnetic</u> Resonance. vol. 59, pp 169-176, 1984.

Bendall, et al. "Theoretical Description of Dapth Pulses, On and Off Resonance, Including Improvements and Extensions Thereof". Magnetic Resonance in Medicine, vol. 2, pp91-113, 1985.

Pauly, et al. "A Linear Class of Large-Tip-angle Selective Excitation Pulses". Journal of Magnetic Resonance, 82, 571-587 (1989).

Vlaardingerbroek, et al. "Magnetic Resonance Imaging Theory and Practice". pp. 164-168; 188-192; 313-317; 392-393; 464-471.

Grant, et al., "Encyclopedia of Nuclear Magnetic Resonance", 1996, John Wiley &

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Sons, Chichester, England XP002216479 pp. 4423-4430. Ordidge, et al., "Single Voxel Whole Body Phosphorous MRS".

ART-UNIT: 2862

PRIMARY-EXAMINER: Lefkowitz; Edward

ASSISTANT-EXAMINER: Shrivastav; Brij B.

ATTY-AGENT-FIRM: Fay, Sharpe, Fagan, Minnich & McKee, LLP

#### ABSTRACT:

A main magnet assembly (12) creates a main magnetic field (B.sub.o) through an imaging region (10). An operator selects sizes and locations of at least two intersecting slabs (72, 74) in a region of interest. A sequence controller (42) includes a gradient synthesizer (44) and an RF pulse synthesizer (46) that synthesize slab select gradient field pulses (80, 82) and magnetization tipping RF pulses (.alpha., .beta.) to tip or rotate the magnetization in the slabs and an intersection region (70). A first RF pulse (.alpha.) and slab select gradient tip the magnetization in the first slab and the intersection region out of alignment with the (B.sub.o) field (FIGS. 5A, 7A). A second RF pulse (.beta.) and slab select gradient tip the magnetization in the second slab out of alignment with the (B.sub.o) field (FIG. 6B) and further manipulate the magnetization in the intersection region (FIG. 7B). Additional RF pulses (-.alpha., -.beta.) and slab select gradients return the magnetization in the remainder of the first and second slabs into alignment with the (B.sub.o) field (FIGS. 5D, 6D) while retaining the magnetization in the intersection region tipped out of alignment with the (B.sub.o) field.

31 Claims, 21 Drawing figures

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	Term	Documents	
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